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COMMONWEALTH PHYTOPATHOLOGICAL NEWS

A QUARTERLY REVIEW OF NEWS AND VIEWS ISSUED BY THE COMMONWEALTH MYCOLOGICAL INSTITUTE, KEW, SURREY

MAIN ITEMS

Sugar-cane Quarantine
Oil Palm Nutritional Problems
"Pool" Investigations
Intensive Propagation for Breeding
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Eastward Spread of Puccinia polysora

SUGAR-CANE QUARANTINE IN HAWAII

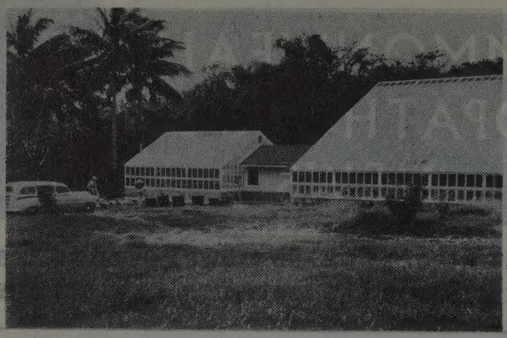
by C. E. Pemberton,
Hawaiian Sugar Planters' Association (retired)

Hawaii is vitally concerned in the protection and maintenance of its sugar industry, which is the largest source of the Territory's income. The estimated value of the crop for 1954 was about $141,000,000, produced on 28 plantations, and employing throughout the year some 20,000 workers, receiving about $62,000,000 in wages. The industry is owned by over 14,000 stockholders, with the majority living in Hawaii. The general standards of living are high and the annual wage of employees exceeds that of any other sugar-producing country in the world. For this reason the margin of profit is small and the need to produce high yields per acre has forced the plantations to give the closest attention to every operation in the field and mills to ensure even a small profit, resulting in 1954 in the phenomenal production of 10·02 tons of 96 degree sugar per acre.

It is evident that the invasion of a new insect pest or disease of sugar-cane, and there are many that have not reached Hawaii, could seriously threaten the present and very moderate profit and badly affect the economy of the Territory.

In close co-operation with the Federal and Territorial governments, the Hawaiian Sugar Planters' Association has been permitted to operate a sugar-cane quarantine technique of its own, which has been highly effective in preventing the invasion of new insect pests and diseases of sugar-cane.

Under present conditions the industry could hardly survive without the frequent utilization of new and superior varieties of sugar-cane adaptable to the varying soil and climatic conditions occurring on the four islands where sugar-cane is grown. Such canes are produced by the geneticists of the HSPA Experiment Station under elaborate cross-breeding programmes, requiring as part of the system the importation from outside countries of many clones of several species of the genus Saccharum. Since 1923, approximately 250 varieties of canes, both wild and cultivated, have been imported as cuttings, together with thousands of seeds. These have all been handled by the quarantine technique described below with completely



Glasshouses for sugar-cane quarantine in Hawaii. Only about one-third of the large house is shown.

satisfactory results. All unauthorized canes entering the Territory are intercepted and destroyed by plant quarantine inspectors as part of their routine duties.

It is of interest that of the several serious foreign insect pests and diseases of sugar-cane now present in Hawaii, all gained entrance prior to the inauguration of this quarantine system, which began in 1923. During that year a number of new canes were imported. These were held in specially constructed quarantine houses in Honolulu. The houses were insulated from the ground by means of a moat surrounding all supports to prevent ants from entering or leaving the building. A dark room with tight doors was provided through which one must pass before entering the quarantine room. Fine copper gauze screening covered three sides, and the upper protion was tightly glassed to facilitate proper lighting. However, with increased importations by 1929,it was felt that for greater security all sugar-cnae in quarantine should be confined to an isolated region on an island where sugar-cane is not commercially grown. The island of Molokai, on whcih no commercial cane is grown, was selected and suitable quarantine facilities were erected. With modifications from time to time the present system has evolved which has required little or no alteration. The installation has been in almost continuous operation in order to deal with the annual importations of foreign canes.

All importations must comply with regulations of the Plant Quarantine and Control Administration of the United States Department of Agriculture and the Hawaii Board of Commissioners of Agriculture and Forestry. This requires written permits in advance from the Federal and Territorial governments when canes are imported from foreign countries, but only from the Hawaii administration for canes from the mainland of the United States. Under agreement with both governments the imported canes are then cared for by a quarantine committee consisting of the Director of the Experiment Station, Hawaiian Sugar Planters' Association, and selected members of his technical staff, who are specialists in genetics, pathology, entomology, and agronomy.

At present, all imported canes, arriving either as seed or cuttings, are handled in a single large quarantine house, shown in Figure 1; this is divided into three sections, consisting of two glasshouses separated by a vestibule. Only about one-third of the large glasshouse is included in the picture. The sides and lower halves of the ends of the glasshouses are screened with fine copper or brass gauze for ventilation purposes. The entire building is surrounded by a moat kept filled with clean water, as indicated on p. 51.

Entrance into the building is through the vestibule in the centre. This is an essential unit for the whole structure. It contains a tight darkroom through which one must pass to enter the small glasshouse where cane cuttings must be grown, a shower bath used before insepcting members pass out of the building, entire changes of clothing worn by individuals who enter either of the glasshouses, disinfectants, tools, etc. Clothes used in the glasshouses are left in the vestibule after use and later sterilized. Disinfectants in the vestibule are used on hands, knives, hand lenses, etc., by visitors before and after leaving the glasshouses containing imported canes. Outside the entrance door to the vestibule is a mat kept saturated with disinfectant through which one must walk upon entering and leaving the building. Only members of the quarantine committee and authorized caretakers are allowed in the building at any time.

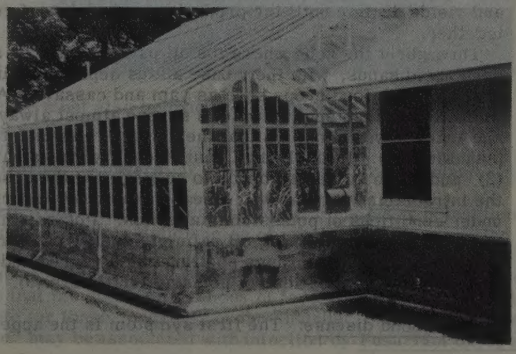
Imported cane cuttings, which are restricted to from 20 to 25 a year, arrive in Hawaii in sealed packages. These are opened in the small glasshouse in the presence of an entomologist and pathologist. The packing material is retained for later incineration or disinfection and the canes are immediately immersed in hot water held at a temperature of 52°C. for 20 minutes. This initial treatment gives fair assurance that concealed insects or their eggs will be killed. Each cutting is then examined closely for evidence of insects, disease or suspicious malformation and then planted in pots of sterilized soil, previously set up in the room. Standard Hawaiian cane varieties, which receive the same treatment, are also planted in pots of sterilized soil and placed in close association with the imported canes in such a manner that as growth proceeds the leaves of both will be in contact. It is felt that this might bring to light some obscure virus or other disease carried invisibly by the imported canes and transmitted to the local canes with recognizable symptoms. All essential data are recorded in a log book kept in the room.

From three to six months later, cuttings are taken from all the canes and given the hot-water treatment as before, and planted in fresh pots of sterilized soil in the same room. All material left from the first plantings, including pots, soil, roots, leaves, etc., is set aside in the room for later sterilization or incineration. The second plantings are then held in the quarantine room until one year after the original planting was made. Frequent inspections are made by an entomologist and pathologist throughout the period of the quarantine. The elimination of insects by the above procedure is a simple matter. Diseases present a greater problem. Should the disease prove serious and clear-cut all of the canes in the quarantine room would undoubtedly be destroyed and the room thoroughly disinfected. As yet this has not occurred.

At the conclusion of the year in the quarantine house, cuttings are taken from each cane, given the usual hot-water bath and planted in a quarantine field situated at least 1,000 feet away from the quarantine house. Here the cane is grown for another year and frequently inspected by a pathologist and entomologist. If no new insect pest or disease appears cuttings are taken from the imported canes, again given the hot-water soaking and released for planting on the other islands. All material left in the quarantine house is disinfected or incinerated and the quarantine room carefully cleaned and disinfected.

Imported cane fuzz, or true seed, is handled in a somewhat different manner. The sealed packages are taken into the quarantine house, placed in a cloth bag freshly dipped in mercuric bichloride solution (1-1,000) and opened while still in the bag. The contents other than the fuzz are dropped in a strong lysol solution. The cloth bag and the fuzz are then made wet with mercuric bichloride solution (1-1,000). Following this, the bag with the fuzz still in it is immersed in a solution of mercuric bichloride (1-5,000) that is heated to 52°C. and held for 20 minutes at this temperature. After a short period of cooling in water the seed is planted in flats of sterilized soil within the quarantine room.

When cane fuzz or true seed has been processed it is planted in the large house. This is necessary because frequently thousands of seedlings sprout from the fuzz and considerable space is required in order to raise them to a size large enough for close inspection and propagation.



The small glasshouse for cane cuttings, and part of the reception vestibule

Six months later cuttings are taken from the seedlings, soaked in hot water for 20 minutes at 52°C. and removed from the house for planting in the quarantine field, situated more than 1,000 feet from the quarantine house. All remaining cane material in the house, including soil and containers, is incinerated or disinfected. The field plantings are allowed to grow long enough to permit ample study and to form stalks of sufficient size from which cuttings can be made. If no disease or new insect appears, cuttings are taken from each variety, given the regular hot-water bath and released for distribution to the other islands.

NUTRITIONAL PROBLEMS IN OIL PALM CULTIVATION IN NIGERIA

by R. A. Bull, W.A.I.F.O.R.

It is already clear that over a wide range of West African soils growth and production of the oil palm are being seriously curtailed by various mineral disorders, and if these can be corrected it seems certain that economically important yield increases can be obtained; probably more rapidly than if reliance is placed solely on improvements in progeny types or cultural practices, despite the spectacular progress made by the Belgians in breeding for oil yields as distinct from bunch weight.

The results of nutritional studies must be applicable to long-established plantations, to areas newly-planted with high-yielding strains, and to the vast areas of semi-wild palm "grove". The improvement of the last-named is a vital part of the West African research programme since 90 per cent. of the palm products exported from our West African colonies still come from areas where the oil palm, although a dominant factor in peasant agriculture, is hardly ever planted or cultivated, but is virtually an "exploited weed". A short account of the progress made to date may be of interest.

Plant palms in West Africa frequently develop various types of yellowing and discolouration of the leaves, usually associated with serious reductions in yield. Mineral deficiencies constitute one of the major problems of oil palm pathology and are the most widespread of all the disorders of that plant. At the West African Institute for Oil Palm Research (W.A.I.F.O.R.), Benin, Nigeria, nutritional research has been concentrated on the diagnosis of mineral disorders, and so far two common disorders have been separated on the basis of visual symptoms.

Confluent Orange Spotting: The first symptom is the appearance on affected leaves of small interveinal rectangular yellow spots. These spots enlarge, deepen in colour to a brighter orange, and assume an irregular outline, until adjacent spots begin to fuse together so that severely affected leaves become covered with a reticulate pattern of lesions. In the ultimate stages of the disorder the tips and margins of affected leaflets necrose and eventually the whole leaf withers and dies. Severely affected palms may lose up to 50 per cent. of their effective leaf area, and yields decline until the production of bunches of commercial value ceases altogether.

Throughout the zone where the oil palm occurs the soils are for the most part deep, acid sands, with their base status depleted by intense leaching or overcropping with food crops such as yam and cassava. Analyses of soils in areas where the orange spot disease is severe almost always show low levels of potassium, and leaf analyses confirm that the disease is associated with subnormal levels of potassium (1). In the Ivory Coast French workers have obtained similar results (2), and there is also evidence to suggest that the susceptibility of the oil palm to the intractable vascular wilt disease caused by Fusarium oxysporum may increase under conditions of potassium starvation. Potassium deficiency is one of the most important factors limiting oil palm yields in West Africa, and F. W. Toovey has shown that confluent orange spotting can be cured and yields dramatically restored in Nigeria by applications of potassic fertilizers (3).

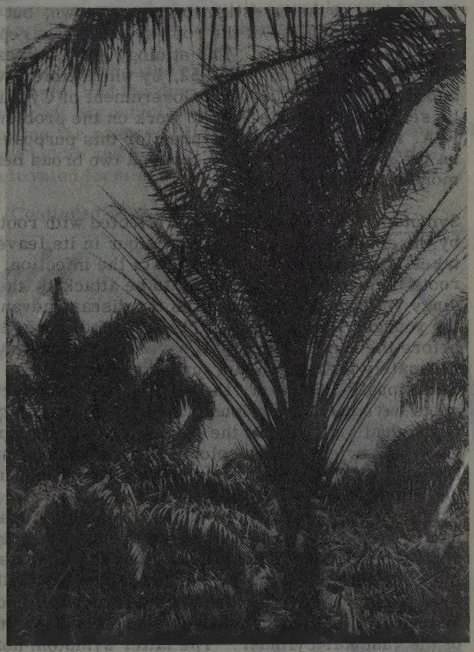
Orange frond disease: The first symptom is the appearance at some point on the

leaflet of diffuse pale green or ochre-coloured areas, which become progressively more yellow in colour and the whole pinna turns bright orange; severely affected leaflets eventually die back from tips and margins.

Injections of solutions containing magnesium into leaflets showing orange frond symptoms have produced recovery, and similar effects have been obtained by spraying affected leaves with magnesium solutions. In addition, leaves affected by the disorder contain only about half as much magnesium as healthy leaves of a comparable age, so it is concluded that orange frond disease is caused by magnesium deficiency.

In March, 1953, applications of magnesium sulphate at the rate of 500 lbs. per acre on a commercial estate caused the disappearance of chlorotic symptoms within nine months. At the moment results are too meagre to permit comment on possible effects of magnesium fertilizers on yield.

Combined Potassium and Mangesium Deficiency: Oil palms may show symptoms of both potassium and magnesium deficiencies simultaneously. Injections of magnesium have so far failed to produce responses in such palms, and it seems likely that under conditions of multiple deficiency responses to one element may be limited by continued deficiencies of others.



A case of 'plant failure'. Note tapered trunk and upright habit of the desiccated lower leaves. (Photo by Prof. Wardlaw.)

Plant Failure: Brief reference must also be made to "plant failure" which occurs where oil palms are growing on degraded soils. This condition is characterized by extreme stunting of growth, an obconical crown shape, and sharp tapering of the trunk, as shown in the illustration. Flowers, if produced at all, are male and abortive.

These symptoms can result from severe and continued deficiencies of potassium or magnesium or both, but acute multiple deficiencies of other elements may also be involved.

Often, isolated cases of "plant failure" may occur at random through an otherwise healthy area. It is possible that the sharp differences of fertility that can occur in acid soils may be responsible for these "pockets" of the disorder. As with confluent orange spotting "plant failure" may be associated with infection by Fusarium oxysporum.

(to be continued)

INVESTIGATIONS BY THE

COLONIAL POOL OF PLANT PATHOLOGISTS

The Colonial Pool of Plant Pathologists (which is financed by the Colonial Office and attached to the C. M. I.) was formed in 1952 to provide a phytopathological service which could be called on at need by Colonial governments to investigate special problems.

The first investigation undertaken by this Pool has now been completed. This was concerned with the cause and control of a disease of broad beans (Vicia faba) in Cyprus. The results of the investigation have been embodied in a report submitted to the Cyprus Government.

Root-rot of Broad Beans in Cyprus

Broad beans are grown in most parts of Cyprus where they form an important addition to the local diet, the fresh or dried beans being cooked and eaten throughout the year For how long this crop has been affected by the disease which formed the subject of the investigation is not known, but in 1933 what was described as "an obscure disease of the root-system" was reported to be causing a considerable loss over a wide area. The etiology of this disease remained undetermined for the next 20 years; and in 1952, by which time it was estimated to be causing an annual loss of £10, 000, the Government of Cyprus asked for a plant pathologist to be seconded from the Pool to work on the problem. Accordingly in January, 1953, R. A. Altson was sent to Cyprus for this purpose. Nearly 18 months were spent on the investigation, which covered two broad bean seasons, each of about 6 months duration.

Symptoms: A broad bean plant affected with root-rot first discloses its condition by the development of a yellow colour in its leaves. The form this yellowing takes is dependent on the course of the infection. If, as is usually the case, the roots themselves are the first to be attacked, the lowest leaves begin to assume a dingy yellow colour, which, as the disease advances, is taken on progressively by the younger leaves above. The yellowed leaves then wither, and, commonly, before the uppermost leaves have changed colour the lower ones are dead. Ultimately the whole plant turns brown and dies. These are the typical symptoms. Occasionally, however, the nodules may be infected and destroyed before the roots have become seriously involved in the attack, and when this occurs there is no gradual yellowing of the leaves, but all, except perhaps the very youngest, assume a bright yellow colour. This abnormal symptom develops early, and the few plants exhibiting it are usually dead by the time the typical symptoms are beginning to appear in the rest of the crop.

In the typical form of the disease, infection may start at the collar (the pathogen having commonly gained entrance through the cotyledonary petioles) and progress down the tap-root and outwards along the laterals; or it may start at any point on the tap-root or on one or more of the laterals. The path of the infection, wherever it may occur, is marked by a blackening and disorganization of the cortex, and usually (but not invariably) by the development of an orange-red discolouration of the vascular cylinder. The latter symptom normally precedes the blackening of the cortex. At the van of the infection neither the cortex nor the vasculars exhibit any discolouration.

Infection never moves upwards into the stem except for a very short distance. When this does occur a dark brown lesion may be found extending from the base of the stem to a few millimetres above soil level.

The yellowing of infected plants can ordinarily be observed about $2\frac{1}{2}$ months after planting, but the disease rarely attracts attention until some three weeks later, by which time small, scattered, circular patches of yellowing plants are beginning to appear. The patches continue to enlarge slowly, and given time, may coalesce until the whole field is involved. Frequently, however, this phase is never reached; for soon after the disease is first detected the beans are ploughed back, and the land prepared for planting with some summer crop.

Etiology: The disease has been shown to be caused by invasion of the root-system by two closely related fungi, namely, Fusarium oxysporum and Fusarium oxysporum var. redolens, the first named being the principal pathogen The forma of the principal pathogen has not been determined, but consideration of the marked difference between the symptoms induced by it and those reported from China has led to the conclusion that it is not the f. fabae which was described by Yu and Fang in 1948 as causing a wilt of broad beans in Yunnan. Reasons are given for supposing that it represents a race of f. pisi.

Macrophomina phaseoli, Fusarium solani, and Corticium solani were also isolated from diseased plants. Of these, only M. phaseoli and F. solani were found to be pathogenic to the variety of broad beans grown in Cyprus. It is, however, considered doubtful whether even these two fungi have anything more than a fortuitous association with the disease, since they were encountered most infrequently, and then usually in company with F. oxysporum.

Dissemination of the disease and viability of the pathogen: The disease is thought to be normally disseminated by the movement of infected soil or plant refuse through the agency of wind, animals, and man. Such evidence as was obtained indicates that it is rarely, if ever, seed-borne.

It was found that F. oxysporum, when present in the soil, can survive six months of virtual drought. Its maximum period of viability is not known, but there are good grounds for supposing that it is not less than three years.

Control: It is considered unlikely that the disease can be economically combated by treatment with fungicidal chemicals, and the development of resistant varieties offers the most hopeful prospect of control. None of the 33 introduced varieties of broad bean tested during the course of the investigation was completely resistant to root rot, but Seville Claudia and Seville Aquadulce showed less susceptibility than the locally cultivated form of Seville Ordinary. It is

(Continued on p. 56)

Killing Capsid with MYSTO Sprayers

Upwards of 20,000 Mysto sprayers like this model 155 are now coming into use in West Africa. Strong and sturdy, they have been specially designed to meet local needs. A major task for them and for the modern insecticides they spray is the destruction of the Capsid Bug.

The manufacturers have a special department dealing with planters' needs. They will be glad to supply further details on request.

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PERSONAL NEWS

Visitors to C.M.I.

Among overseas visitors to the Institute have been Dr. D. Stenderup, Denmark, Dr. M. Kamel and D.Y. Kami, Egypt, Robert J. Hans, Michigan, Dr. R.D. Rands, Florida, Prof. J.C. Walker, Wisconsin, F.E. Fisher, Florida, Prof. A.J. Riker, Madison, U.S.A., Dr. J.M. Waterston, Nigeria, Kishan Singh, India, Dr. G.M. Wickens, Uganda, J.S. Hemingway, Tanganyika, Dr. W.T. Dale, Trinidad, A. Thompson, Singapore.

Appointments, Transfers, and Retirements

The following appointments have been announced by the Overseas Service Division of the Colonial Office —

A.G. Bailey and O.P. Jones as Probationer Plant Pathologists in the Northern Region, Nigeria, and Tanganyika, respectively.

Paul Holliday has been appointed to the Colonial Pool of Plant Pathologists and has now sailed for Sarawak to join R.A. Altson in the study of the wilt disease of pepper.

Dr. C.J. Hickman has been designated reader in mycology at Birmingham University.

On his return from an assignation with F.A.O. as technical adviser to the Philippine Government, Dr. R.S. Vasudeva, Head of the Division of Mycology and Plant Pathology, has been appointed Assistant Director of the Indian Agricultural Research Institute.

Dr. H.E. Young is retiring from the post of Director, Rubber Research Institute of Ceylon.

Miss Dorothy Shaw, of the University of Sydney, Australia, has been spending the last two years at the Science Service Laboratory, Winnipeg, Canada, where she has been working under Dr. T. Johnson on Septoria diseases of cereals. Miss Shaw, who is the holder of a Thomas Lawrance Pawlett Scholarship from the University of Sydney, recently took her Ph.D. at the University of Manitoba, and will visit plant pathology research centres in the United States during the summer on a Rockefeller Foundation grant. (Information supplied by Department of Agriculture, Canada.)

Award

G. Orian, recently retired Plant Pathologist, Mauritius, was awarded the M.B.E. in the last Birthday Honours.

List of Scientific Liaison Officers

Address: Africa House, Kingsway, London, W.C. 2.

Dr. V. Armstrong, Chief Scientific Liaison Officer for New Zealand (Chairman)
Dr. J.G. Malloch, National Research Council of Canada
Mr. Walter Ives, Chief Scientific Liaison Officer for Australia
Mr. A.M. Schady, Chief Scientific Liaison Officer for South Africa
Dr. S. Krishna, Chief Scientific Liaison Officer for India
Mr. J.E.C. Coventry, Chief Scientific Liaison Officer for Rhodesia & Nyasaland
Dr. K.A. Davies, Commonwealth Geological Liaison Officer
Mr. J. Croston, Secretary, BCSO (Lond.) Committee

(Continued from p. 55)

recommended that the first two varieties should be given a further trial and also that the search for complete resistance should be continued, preferably among the Seville varieties. Of the three infected sites available for tests of resistance, a field at Mandria is the most favourable, the soil being good and water readily available Special attention would have to be paid to manuring on either of the other sites owing to the comparative infertility of the soils. The possibility of isolating a resistant strain from Seville Ordinary should also be borne in mind.

NOTES FROM CANADA

PLANT GROWTH CHAMBERS AND THEIR USE IN PLANT BREEDING

Introduction

Plant breeders are being confronted continuously with new breeding problems which demand more skill, control, and better methods for the detection of superior plants, so that it is essential to resort to speedier ways of growing early generations of the hybrids. Once the hybrids are homozygous they may be increased and subjected to adequate disease epidemics and tested for general adaptability under natural environmental conditions. In the past plant breeders have conducted their work almost entirely in the field and greenhouse, which, however, have many limitations and hazards, such as shortness of season and inadequate control of light intensity, temperature, and moisture; and improper balance of these affect the fertility of the crop. With good management three generations of spring and one of winter cereals may be grown per year by the use of the field and greenhouse.

With the use of the plant growth chamber all the hazards which are experienced under field and greenhouse conditions can be eliminated. Moreover, the artificially controlled chambers are in season the year round and conditions required for growing spring, winter, and perennial plants can be adjusted to suit the crop. Five generations of spring barley have been grown in one year.

The plant breeders at the Cereal Crops Division at Ottawa are using four plant growth chambers. One of these, which may be operated at a temperature as low as 35°F., serves chiefly for the growing of winter cereals and in studies of frost hardiness and seed dormancy. The remaining chambers are chiefly operated at temperatures of 60°-75°F.

The chambers are built below ground in what were formerly basement grain storage rooms. Light for photosynthesis is supplied almost wholly by fluorescent lamps wired into a panel which hangs over the soil beds on benches and can be adjusted vertically to provide light for the plants. These lamps need special electrical equipment such as starters or ballasts to increase the voltage. In the chambers, considerable heat is given off by the lamps and therefore a cooling system is necessary, so provision has been made for changing the air in the chambers. Details on most of these points follow.

The Size of the Plant Growth Chambers

The first chamber, constructed in the autumn of 1951, is $17 \times 12 \times 7\frac{1}{2}$ feet. It holds two growing benches 5×8 ft. $\times 6$ ins. deep and can be fitted with an additional 5 in. frame so that a soil bed of 11 ins. is possible. Single plants are usually grown in 4 in. pots filled with soil. Along the wall and between the two benches a walking space of 2 ft. is provided. The three new chambers which have just been completed are smaller rooms; two are $5 \times 12 \times 7\frac{1}{2}$ ft. and one $9 \times 12 \times 7\frac{1}{2}$ ft. The benches are smaller so as to conform with the size of the room and the overall measurements of the lighting panel. The choice of small or large rooms will depend upon the nature of work to be undertaken. However, the whole set-up becomes more flexible by using several small rooms rather than one large one, particularly since all crops, or even varieties within crops, do not always respond equally well to the same set of conditions.

The Lighting Arrangement and Equipment

The frame of each lighting panel is constructed of 1 in. steel piping and angle or flat iron, depending on the type of lamp holder which is used. The panel is vertically adjustable by means of counter weights, pulleys, and cable, or worm and gear with pulley and V-belt. A vertically adjustable panel assures full usage of all the available light. The fluorescent lamps used are 8 ft. long with a diameter of either 1 or $1\frac{1}{2}$ ins. The technical designation of the 1 in. by 8 ft. lamp is F96 T8, C.W. and the $1\frac{1}{2}$ in. by 8 ft. lamp F96 T12, C.W. A third type of lamp developed recently is the $1\frac{1}{2}$ in by 8 ft. lamp known as F96 T12, R/S, C.W. R/S denotes rapid or instant start lamp. The lamp holders used are of 2 and $1\frac{1}{2}$ in. widths. The latter are being used in connection with the F96 T8 lamp. The spacing

between the sockets is $\frac{1}{4}$ in. When T8's are used in place of T12's an extra lamp can be placed in the frame for every 4 lamps of the T12's.

The auxiliary lamp equipment consists of a starter called a ballast. This ballast transforms the 110 volt A.C. 60 cycle current to 525 or 650 volts, A.C. open load. In this operation 24 watts or so are lost from the ballast in the form of heat, so that the former are installed outside the growth chamber. Each ballast operates two lamps. The F96 T8 and F96 T12 lamps may be both operated at a current density of 430 milliamperes and 75 watts per lamp, but the ballast operating the F96 T12, R/S is rated at 800 milliamperes and each lamp at 100 watts. The three types of lamps were installed in the new lighting panels for the purpose of comparing their efficiency under similar operating conditions. The quality of the spectrum of the three lamps is regarded as equal in all respects. The lighting panel of the first chamber constructed was installed entirely with F96 T8, C.W. lamps and the 430 milliampere ballast.

The Life, Light Intensity, and Spectrum Quality of the Lamp

The life of the lamps is rated at about 6000-7000 hours for one start per day. The writer has had no experience with more than one start per day, but it is claimed that the life expectancy is somewhat less when several starts per day are being used. The depreciation in lumen output is about 10 per cent. during the first 1000 hours, and towards the end of the above life expectancy falls to about 60 per cent. of the initial output.

The initial light intensity in foot candles for three recently installed light panels is as follows:-

A. 430 ma. ballast, T8 lamps: 3133 foot candles at 60°F.
B. 430 ma. ballast, T12 lamps: 2077 foot candles at 60°F.
C. 800 ma. ballast, T12, R/S: 2433 foot candles at 60°F.

From these results it seems almost certain that the T8 lamps operated by the 430 ma. ballast are possibly the best ones to use for plant growth chambers. In fact, the first lighting panel installed used T8 lamps and the 430 ma. ballast.

The extra foot candles obtained from the T8's as compared with the other two lamps is due, in part, to the fact that 430 ma. rather than the specified 300 ma. are sent through the tubes.

The spectrum quality of the lamps ranges between the wave lengths of 4000 to 7000 Angstroms with a high peak in the blue and red. At Ottawa, the fluoreseent lamps are supplemented with about 10 per cent. of their wattage by light from incandescent lamps. This combination results in a spectrum quality suited for cereal growing.

Temperature Control Equipment

Each temperature controlled growth chamber requires cooling. This is done by a water-cooled freon compressor and condenser. The condenser in the original growth room is located inside the chamber. The new chambers have the condensing coils located in the compressor room, and the cold air is forced through galvanized sheet iron tunnels. Above the light panels is located an air outlet that draws off heated air which is re-conditioned in the condenser. One 5 h.p. water-cooled freon compressor operates three condensers and these in turn are controlled separately by selonoid valves. The diurnal clocks control night- and day-time thermostats within $\pm$ 2°F.

Ventilation

A damper device and blower fan provide fresh air at a rate which allows for one to 10 changes per hour. The results so far would indicate that five air changes per hour are sufficient.

Control of Day Length

The day length is controlled by a series of time clocks, which may be set for one or several time intervals depending on the crop to be grown. For cereals an 18-

hour day length with an additional 6 hours photoperiodic stimulus from the incandescent source of light is giving good results; with spring cereals, satisfactory results were obtained when the plants were fully illuminated for 18 hours and, as a photoperiodic stimulus, with only the incandescent lights for the remaining 6 hours per day.

The Growth Chamber Equipment Applied to Hasten Practical Plant Breeding

The following procedure is applicable to the use of the growth chamber for important hybrids. A somewhat similar plan, as outlined below, was followed with spring barley and wheat.

1. F_1, produced in greenhouse and ready for seeding in control chamber on March 1st.
2. F_2, grow in growth chamber.
3. F_3, increase population in field, select for disease resistance, vigor, etc.
4. F_4 to F_6, grow in growth chamber during the winter.
5. F_7, plant in field for observation, selection, and increase about May 1st.

This system of breeding is advantageous for handling backcross populations. In the past, experience has shown that sometimes F_0 seeds from the greenhouse are too late for field plantings. In such cases, the F_1 plants can be brought along in the growth chamber and later transferred to the field for a disease test or other similar tests. Moreover, important hybrids from the field may be planted immediately rather than be delayed until such time as lower greenhouse temperatures are available.

Tiller propagation of valuable F_1 plants or perennial strains may be made by transferring them to a vegetatively conducive climate. Winter wheat hybrids are sown in trays for preliminary treatment at a temperature, between 35°F.-40°F., and an 8-hour day and then transplanted to the field, or they may be grown to maturity in the growth chamber and later planted in the field during the autumn.

Summary of the Advantages of a Controlled Growth Chamber

1. It is possible to grow five generations of cereal crops per year.
2. There is adequate control of environmental conditions for tests with different varieties and strains of cereals.
3. The growth chamber is always in season and projects can be started at any time of the year.

Cereal Crops Division, [illegible] F. Gfeller
Central Experimental Farm,
Ottawa, Ontario, Canada.

SOUTH AFRICAN NOTES

Concentric Ring Blotch of Citrus: Concentric ring blotch has puzzled pathologists for many years. Now Prof. B. J. Dippenaar of the Agricultural Research Institute of the University of Pretoria has evidence that it is caused by the eggs of an undescribed 4-legged mite, presumably by a toxin released from them. He can reproduce the disease at will in the glasshouse. Ring blotch became very destructive in some districts a few years ago, probably it now seems, because growers stopped treating their trees with sulphur, to which the mite is sensitive, and changed to the new phosphorus insecticides, to which the mite seems to have some resistance.

Prof. Dippenaar expects to publish some results soon in Farming in South Africa.

Other citrus diseases that have been ascribed to mites are Argentina's lepra explosiva and Florida's leprosis or nailhead rust.

Late Blight of Tomatoes: Tomatoes this season fetched unusually high prices because blight destroyed many of the crops. Late blight flared up in the United States in 1946, and prompted the survey which Miller and O'Brien made and gave

an account of in Plant Disease Reporter, Supp. 231, 1955. South African experience has been somewhat parallel. In 1951 blight was found in Natal and this was the first record for almost 30 years. Since then it has remained as probably the most important disease of tomatoes. It occurs at the coast and far inland, in summer-rainfall and winter-rainfall regions, with and without irrigation, at high altitudes and at low, and over a wide range of temperature and rainfall. Clearly, P. infestans likes the country, and the mystery is why it postponed settling on tomatoes until 1951. There was no sudden increase in the acreage of tomatoes then, and blight has been with us for many years on potatoes. One hopes without conviction that it will prove to be a disgruntled immigrant to tomato fields and go away again, as it did in 1923 when we had our last record of blight on tomatoes before 1951.

J. E. van der Plank

NEWS FROM NEW ZEALAND

Methods of Testing Plants for Resistance to Phytophthora: During my investigations of Phytophthora diseases it became apparent that many varieties of plants had resistance to this pathogen. Particularly in the case of apple rootstocks, resistance to crown and collar-rot caused by Phytophthora cactorum appeared to be a valuable attribute in New Zealand orchards. Similarly with hops, resistance to black root-rot (Phytophthora cactorum var. applanata) was becoming a necessity in the main hop growing district. In Western Samoa canker and black pod of cacao, both caused by Phytophthora palmivora, have caused very serious losses in both trees and pods. Resistance to both diseases has long been recognised as a valuable attribute. Hence the introduction of Forrestero Seed to replace Criollo, which was more susceptible to canker, and the selection of Lafi 7 for field resistance for black pod. Methods of testing apple varieties and root stocks, cacao, and hop seedlings for Phytophthora resistance were therefore investigated and the following methods found satisfactory:

I. Small pieces of agar cultures were inserted in a cut in the bark of the apple tree and the radial extent of lesion measured after one month. This method was most successful in determining relative susceptibility of apple varieties to collar-rot.

II. Small pieces of root about $1\frac{1}{2}$ in. long were taken close to the crown. These were surface sterilised in sodium hypochlorite solution, rinsed in water, and then dried on a clean cloth. A thin slice was cut from the end of the root and the cut surface placed on an agar culture of Phytophthora in a sterile preserving jar. Small plastic labels were attached to the root by rubber bands. The lids were loosely attached and the jars incubated for 6 days at 25°C. The extent of bark or cortical rot was then measured. This method was most satisfactory for crown rot of apple stocks and black root-rot of hops.

III. A modification of the second method was used to test cacao seedlings for resistance to canker and cacao pods for resistance to black pod. Pieces of the branch of the seedlings about 6 ins. long were taken from each tree and the freshly cut surface at each end painted with a sporangial suspension of P. palmivora. The branch pieces were then labelled and wrapped in plastic bags for six days. After that time the surface of the bark was removed and the extent of rotting measured. Detached cacao pods were inoculated with a sporangial suspension and wrapped in plastic for six days before recording the type and amount of infection.

Consistent differences in resistance to Phytophthora infection were found for apple varieties and rootstocks, hop seedlings, and cacao (pods).

Harvey C. Smith

PHYTOPATHOLOGICAL NEWS FROM INDIA

Antifungal antibiotic: At the Bose Research Institute, Calcutta, Banerjee, Mukherjee, and Nandi have isolated 196 strains of different species of Streptomyces from 50 samples collected from different parts of India. Of these, 42 strains were found to produce a certain amount of antifungal antibiotic.

Role of Zinc in Fusarium Cotton Wilt: At the Botany Laboratory, Madras University, Kalyana-sundaram, while studying the role of zinc and manganese on the susceptibility of the cotton variety Karunganni 2 to Fusarium vasinfectum, has reported that the addition of zinc caused an increase in ascorbic acid and carbohydrate contents of the plants, possibly through auxin production, which may account for their increased resistance to Fusarium vasinfectum.

Ability of Insect Vector to carry more than one Virus at a Time: In the virus-vector relationship studies, whitefly (Bemisia tabaci) has been found to carry three viruses simultaneously, namely yellow vein mosaic of bhindi (Abelmoschus esculentus), yellow vein mosaic of pumpkin (Cucurbita pepo) and yellow mosaic of double beans (Phaseolus lunatus).

Pomegranate Leaf Spot: A new bacterial leaf spot disease of pomegranate (Punica granatum) has been studied. The causal organism has been identified as a new species of Xanthomonas and named X. punicae, as it is specific to its natural host. The disease is favoured by high temperature and low humidity. The pathogen survives from crop to crop in the dried fallen leaves.

Mango Leaf Spot: A leaf spot and twig blight disease of mango (Mangifera indica) has been worked out in detail. It is caused by a species of Macrophoma. A mutant strain of the pathogen was obtained by exposure to ultra-violet irradiation, and differs from the parent in its ability to form mature pycnidia in abundance in 7 to 10 days as against the scanty pycnidial formation in the parent culture after 30 to 40 days. The mutant strain further differs in having smaller pycnidia and pycnospores and greater virulence as judged by the reduced incubation period. The host range of the two cultures, however, remained the same. A perithecial stage of the mutant strain, tentatively identified as belonging to Phomatospora species, has been obtained in culture.

Some New Future Plans: The Government of India have announced their second Five Year Plan for the development of Agriculture and Industry. In this connection several new schemes have been started for research and extension work in Mycology and Plant Pathology. Some of the new schemes envisage the use of atomic energy in Plant Pathology, the establishment of seed testing stations, and intensive research on bacterial plant pathogens and plant viruses.

R. S. Vasudeva

NOTES FROM SOUTHERN RHODESIA

Severe outbreaks of late blight (Phytophthora infestans) have devastated summer potato crops in the main producing districts for the past three seasons. Race (4) was found to be the most widely distributed biotype in the first epiphytotic although, since the introduction of blight resistant varieties, the specialised races (3, 4) and (1, 4) have also appeared. No late blight was recorded from Matabeleland until March, 1955, despite its prevalence in other parts of the country.

Two exceptional spells of late rain in April and May last were followed by a subsidiary outbreak of late blight amongst irrigated potatoes in the Salisbury district.

Tropical maize rust (Puccinia polysora) was first detected this year at Shamva in January, six weeks earlier than in previous years. In subsequent surveys the disease was found throughout the Mazoe valley, becoming less intense at the higher altitudes. It was also discovered in the Hartley-Gatooma maize belt but here, as

elsewhere, the crops were well advanced and infection of recent occurrence. This extension of the disease to new districts was probably favoured by warmer weather than average coupled with a high seasonal rainfall. Despite this apparent spread of tropical rust no serious losses due to the disease have been reported. Rust was again severe in late maize plantings in the low veld. Zineb sprays applied weekly to experimental plots in this region gave satisfactory control of the disease and indicated that yield losses were of the order of 25 per cent.

Cob-rotting diseases have been prevalent this season and more grain infection by Diplodia zeae observed than for many years past. D. macrospora was determined for the first time in Southern Rhodesia from diseased maize cobs. Symptoms closely resemble those caused by the better known D. zeae. D. macrospora has also been recorded in recent months causing a leaf spot and stalk rot of maize. The same organism proved to be the dominant pathogen in samples of discoloured maize grain received from Nyasaland.

Leaf and stem spot of Greenfeast peas (Pisum sativum) due to Cladosporium cladosporioides f. sp. pisicola appeared in several crops grown from imported seed. Many infected plants were stunted and deformed.

Irrigated plantings of San Marzano and Marglobe tomatoes in the Eastern Districts low veld were attacked by leaf mould (Cladosporium fulvum). In the case of the former variety, which is grown extensively for canning purposes, the infection was particularly severe.

G. R. Bates

The Spread of the South American Maize Rust

The progress of the South American maize rust (Puccinia polysora) continues unabated. Known for many years only from Central America and the Caribbean region it appeared in Sierra Leone in 1949, spread rapidly through West Africa then Central Africa, and has since invaded almost the whole of Africa South of the Sahara.

It reached Madagascar, Réunion, and Mauritius in 1953 and now has been reported by Mr. L. Orieux from Agalega Island 500 miles north of Mauritius. Specimens collected by Mr. Raymond Mamet, Assistant Entomologist, on a visit to the Island in 1955 were referred by Mr. Orieux to Puccinia polysora and this identification has now been confirmed by the Commonwealth Mycological Institute.

The importance of this new record is that it constitutes a definite threat to India, Pakistan, and Ceylon. Rust spores can travel long distances in the air, and one wonders how much further the fungus will travel. These countries have been informed and the Colonial Office has asked for specimens of diseased maize leaves found on any of the islands in the Indian Ocean to be sent to the Commonwealth Mycological Institute for identification.

During the investigations carried out by the Maize Rust Unit in West Africa varieties showing a high degree of resistance to the disease have been obtained so that ultimately control of the disease by resistant varieties should be feasible. In the meantime the cultivation of resistant varieties in the islands of the Indian Ocean might be encouraged and the bulking up of seed of varieties resistant of the fungus considered in the threatened countries in readiness for what may well be a serious invasion.

S. P. W.

Penicillin Production in India

Penicillin is now being produced in India at Pimpri, near Poona. It is expected that the factory will produce 20 million mega-units annually, sufficient for India's own requirements, for the first few years, and will eventually step up production to 32 million mega-units, when export is anticipated.

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Citrus canker in the Belgian Congo

A recent report by J. Philippe in the Bull. Inform. Inst. Etud. agron. Congo belge, 4, 1, pp. 20-21, 1955, confirms the presence of Xanthomonas citri in the Belgian Congo [see C. M. I. map No. 11] where it seriously affects grapefruit, oranges, and mandarins. The disease was observed at Kisantu.

Panama Disease of Bananas in Uganda

Mr. Jamieson, Chief Research Officer, Uganda, reports that the symptoms of Panama disease of bananas (due to Fusarium oxysporum var. cubense) were recently detected by Mr. Baldwin in the Bugisu district, Mount Elgon, in a large banana growing area. The disease has now now been recorded completely across the country. As in all previous records the effect on the crop is slight.

CACAO CONFERENCE

The annual conference of the Cocoa, Chocolate and Confectionery Alliance was held in London from 13th to 15th September and was attended by Dr. Wiltshire. A short report on matters relevant to the phytopathology of cacao will appear in the next issue of C. P. News.

TRANSMISSION OF DISEASE

Symposium Arranged by the Institute of Biology

Matters of phytopathological and mycological interest were prominent during the 6th annual symposium held from September 29th to October 1st at the London School of Hygiene and Tropical Medicine under the auspices of that young and active body the Institute of Biology. Some twenty papers were contributed including those by G. C. Ainsworth (fungi pathogenic for man and animals), J. E. Crosse (bacterial plant pathogens), S. D. Garrett (soil micro-organisms), J. W. G. Lund (fungal diseases of plankton), P. K. C. Austwick (insect transmission of fungi), Mary Noble (seed-borne pathogens), F. C. Bawden (plant virus transmission by insects), and W. C. Moore (diseases and plant trade). The full report will be published by the Institute of Biology in the spring of 1956 at about 15/-.

University College of the Gold Coast

The Faculty of Agriculture has issued a guide to the Agricultural Research Station at Nungua, dealing with all the phases of teaching and experimentation now being undertaken, and with short notes on experimental results already obtained. Rust resistance trials against Puccinia polysora are in progress.

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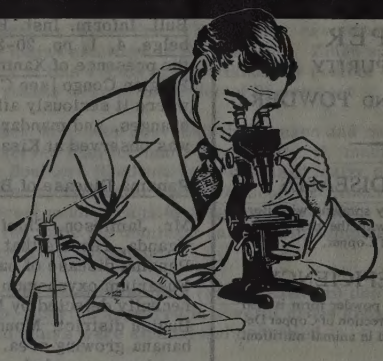

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